
D&D of a Former Beryllium Machine Shop

Gary E Whitney, CIH

Industrial Hygiene & Safety Division

Los Alamos National Laboratory

Disclaimer

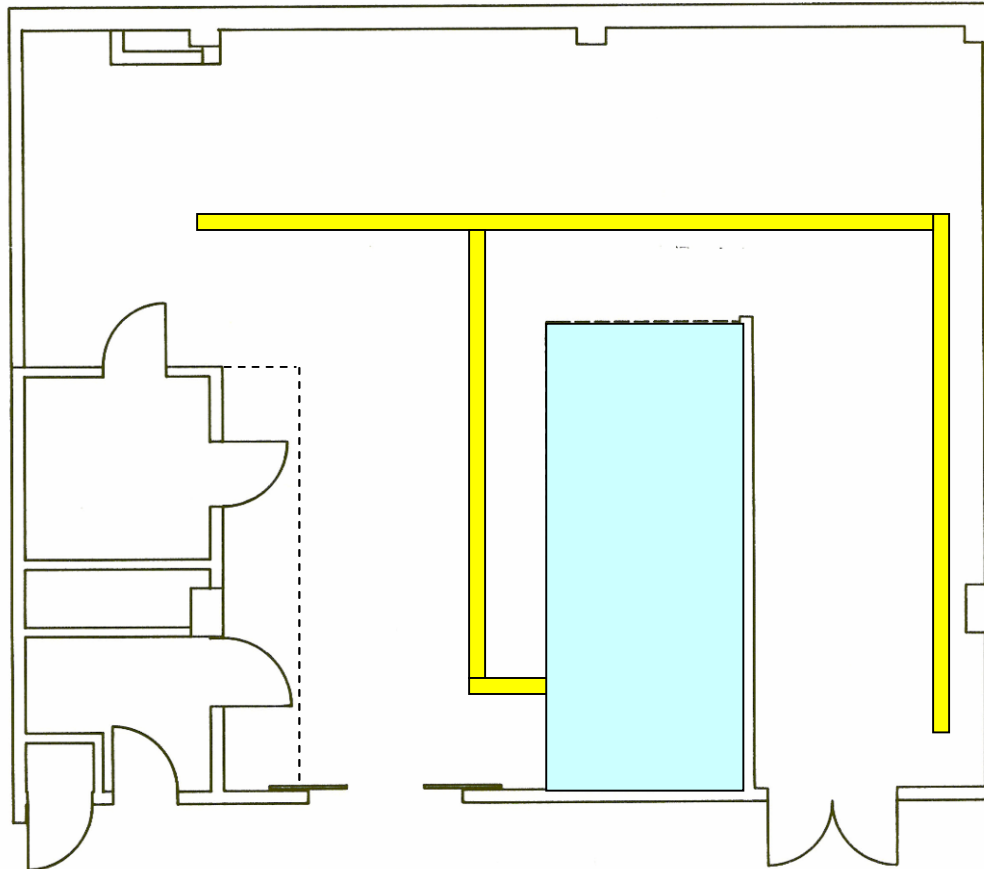
Any reference to products, companies, persons, or organizations is for information purposes only and does not represent any form of endorsement or criticism.

Opinions expressed are those of the author only and do not represent those of Los Alamos National Laboratory or the National Nuclear Security Administration.

Background

- Principal beryllium machine shop at LANL from '53 through '99.
- By 2000, beryllium machining operations were transferred to the Beryllium Technology Facility. In 2007, funding was secured to remove the residual beryllium hazard.
- Security concerns over small classified parts entrapped within the ventilation system further complicated the already challenging D&D task.
- Room 16 is ~1800 sq. ft. with 22' ceiling and a cement block enclosed mezzanine to house ventilation system.
- Exhaust ventilation system consists of ductwork, dynamic precipitator, bag-house, HEPA filters, fan and stack.

Beryllium Shop Floor Plan

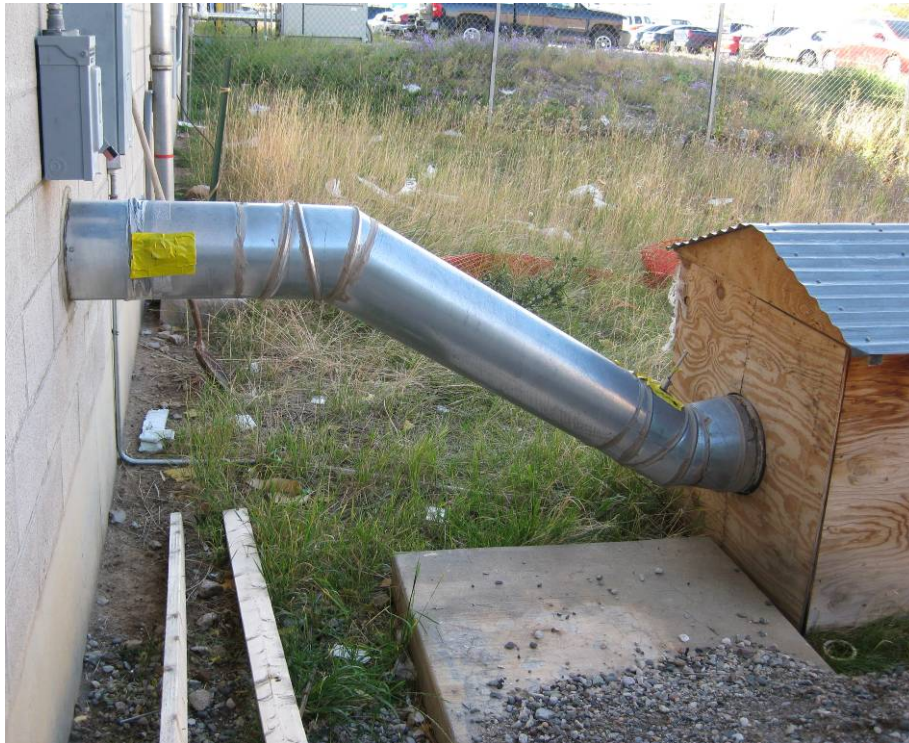


Shop is approximately 50' x 36'. Elevated mezzanine in blue.
Main duct in yellow.

Supplemental Exterior Ventilation

- A problem with the dynamic precipitator in 2000 required a ventilation system shutdown for repairs.
- Ventilation system normally on 24/7 to keep shop negative in respect to hall. Concerns of contamination spread.
- Solution was a HEPA clean-air machine (~800 cfm) installed outside building and connected via a duct through the wall.
- This additional ventilation was not installed as part of this project, but it certainly provided an advantage and should be considered for similar jobs.

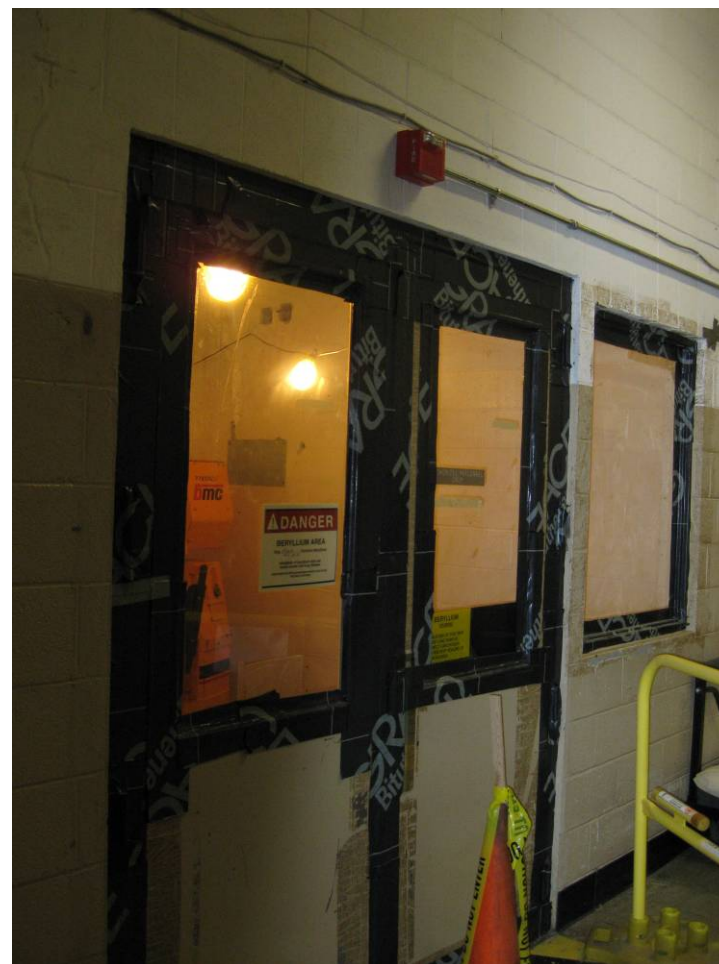
Supplemental Exterior Ventilation



Keeping Contamination In Unoccupied Shop

- When in operation the beryllium machine shop had daily cleaning; routine surface wipe samples were collected; ventilation system was checked daily; and air samples were collected for all machining operations.
- All this served to constantly monitor the situation and control contamination spread.
- Concerns were raised over how to maintain control when the shop was no longer operational and unoccupied.
- Chosen solution was to seal in the shop.

Sealing Shop Doors and Windows



Summary of Project

Project was broken down into two phases

- Phase I
 - Removal of ductwork and held-up material.
 - Removal of material from ventilation system hoppers.
 - Sectioning and packaging of ductwork.
 - Applying lessons learned to Phase II planning.
- Phase II
 - Dismantling, packaging and removal of ventilation system.
 - Removal of all remaining shop equipment and materials.
 - Removal of all fixtures and HVAC system.
 - Decontamination and painting of all surfaces.

General Health & Safety plan

- Engineering Controls
 - Shop ventilation system (for Phase I).
 - Clean air machine.
 - Portable HEPA ventilation system.
 - HEPA vacuums.
- Contamination Control
 - All but one door sealed.
 - Plastic wrap and bags.
 - Glove changes (multiple gloves, inner glove taped).
 - Spray cleaner and wipes.
 - Staged doffing areas.
 - Sticky mats.

General Health & Safety plan

- Personal Protective Equipment
 - Modesty scrubs, coveralls with hood and booties, taped inner gloves.
 - Outer gloves, outer booties, and outer coveralls (task dependent).
 - Full-face P100 APR or PAPR (task dependent).
 - PPE progressively doffed through buffer areas.
- Administrative
 - Access control; Signs and labels.
 - Training and Work Control.
 - Weekly planning meetings; Daily pre-job meetings.
 - Personal, area, and surface sampling.
 - Hygiene facilities & practices; Shower at end of shift.

Phase I: Remove the Ductwork



Before Phase I



After Phase I

Phase I: Empty the Hoppers



Dynamic Precipitator



Bag-house Hopper

Phase I: Highlights

- Crew safely removed ~300 linear feet of contaminated duct (Main, branch lines, and trunk hoses included).
- Duct waste was wrapped and stored in compliance with Fire Marshal and WMC for Phase II.
- Removed and secured one 30 gallon and four 55 gallon drums of Be security material. (~150 kg chips, dust, and debris from ducts and hoppers that may contain small classified parts or scraps.)
- Job completed ahead of schedule; without any safety incidents, spills, or releases; and with airborne levels of beryllium well below what had initially been anticipated.

Phase II: Equipment & Material to be Removed



Phase II: Equipment & Material to be Removed



Phase II: Equipment & Material to be Removed



Phase II: Equipment & Material to be Removed



Challenge: Removing Contaminated Items

How do we get this stuff out of here?

- The north wing of the building has a central hallway.
- The only doors to the old shop open onto this hallway.
- Occupants of the north wing are very concerned about beryllium exposure and contamination spread.
- Some items in shop are very large may be heavily contaminated.
- There is no space for a cleaning and packaging buffer area.

If No Door, Make a Door

- Major security concern for limited area.
- A lot of work to come up with a plan that met all security requirements, was feasible to build, and would suit the purpose for which it was intended.
- Location must be selected, the area prepared, door fabricated, materials positioned, work scheduled, and everything ready to go before any wall penetration can be made.
- Must be installed and secured in one day unless guards are stationed.

Exterior Wall of Shop



Interior View of Added Door



Transportainer Sealed to Exterior Door Frame



Transportainer Sealed to Exterior Door Frame



Packing Transportainer With Waste



Packing Transportainer With Waste



Sealing Packed Transporter

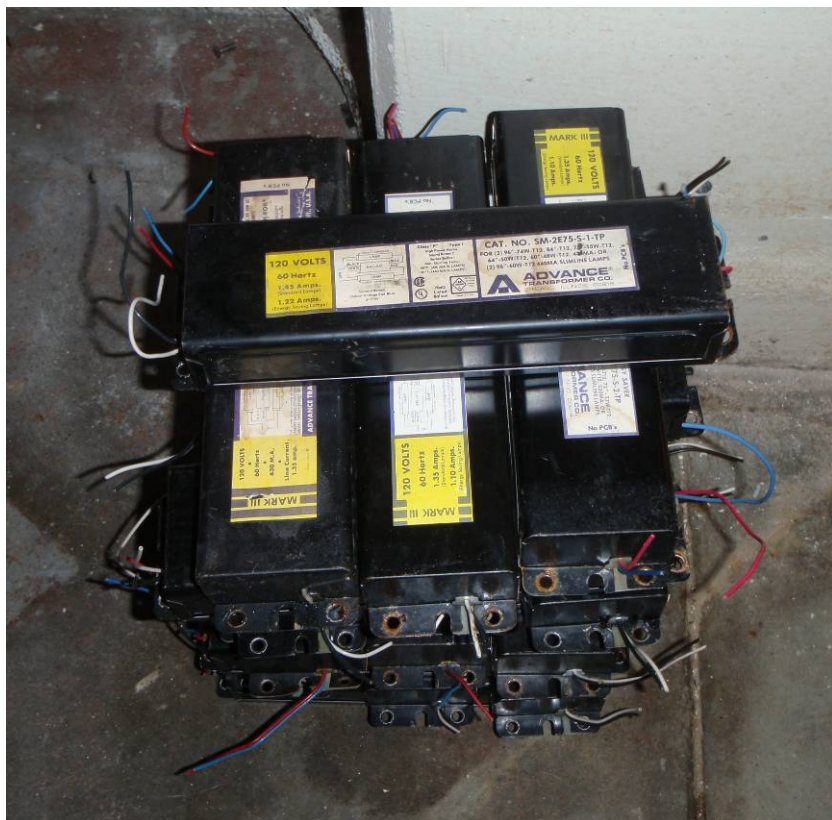


Issue: Keeping Waste Streams Separate



- Machines may contain unexpected subcomponents.
- Required transportainer “dumpster diving” and re-packing.

Issue: Keeping Waste “Clean”



- Hazardous wastes had separate disposal pathways.
- Decontamination of surfaces required before disposal.

Ventilation System in Mezzanine



Ventilation System in Mezzanine



Ventilation System in Mezzanine



Ventilation System in Mezzanine



Ventilation System in Mezzanine



Another Challenge: Accessing Mezzanine

- The only mezzanine access was through an elevated door that opened onto a platform above the north wing hallway.
- The narrow metal platform and ladder were removed during an earlier ventilation system repair and replaced with a temporary platform and stair.
- During Phase I workers accessed mezzanine through the hallway door. Workers exited the space through a buffer area that allowed doffing outer PPE.
- Not considered acceptable for Phase II. No materials out through hallway.

Solution: Keep Door Sealed; Knock Out Wall



- Door to hall remained sealed.
- Knock out back wall of mezzanine into shop.

Breaking Down the Bag-House

- Limited space and concerns over small classified parts required the bag-house to be dismantled.
- Inlet and outlet ducts removed. Door was opened and a portable HEPA exhaust system was attached to bag-house outlet, creating a “hood” for bag removal.
- All bags removed, packaged, and secured in drum.
- Top of hopper covered with plywood and upper bag-house dismantled.
- Dust HEPA vacuumed from hoppers. Hoppers inspected.
- Pieces wrapped and removed with crane.

Tools of the Trade: Soon to be Trash



Getting It Down: Crane, Scaffold, Ladders



God Makes it Interesting: Hail Damages Roof



Significant Hazard: Heat Stress



Near the End, Almost Finished



Summary of Exposure Monitoring

Parameter	Phase I		Phase II	
N	42		155	
Mean	0.58 ug/m ³		0.33 ug/m ³	
SD	0.63 ug/m ³		1.06 ug/m ³	
Maximum	2.23 ug/m ³		11.8 ug/m ³	
< Reporting Limit	3	7.1%	47	30.3%
> Action Level	27	64.3%	51	32.9%
> PEL	2	4.8%	2	1.3%

Personal breathing zone samples; 8 hour TWA in ug/m³.

Key to Success: Qualified, Experienced Workers



- These are the people that make things happen.
- Listen to them and keep them involved in all aspects of job.

Phase I & II: Notes & Lessons

- A great deal of credit must be given to the workers!
- Retention of experienced workers and staff for Phase II considered essential.
- During daily pre-job meetings and rest periods there were productive, interactive discussions between the workers, supervisors, project managers, and IH staff.
- Initial estimate of 20 kg of beryllium was very low. More likely that 200 kg of beryllium was removed.
- Retained material was not just beryllium. It included other metals machined in the shop, cleaning tissues, rags, paper, household dust, and oil from lubricants.

Final Steps

- Floor will be surfaced with a filler/sealant.
- All surfaces will painted a dark color (e.g. deep red).
- Top coat of a lighter, contrasting color (e.g. beige) will be applied so wear through the top coat will be visible.
- Install new lighting and electrical.

Questions



Gary Whitney, CIH
Los Alamos National Laboratory
P.O. Box 1663, Mail Stop K494
Los Alamos, NM 87545

whitney_gary@lanl.gov
(505) 665-8549